Matlab code notes for Neural Field Model

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1 Convolution of Two Gaussian basis functions

Analytically prove convolution of two Gaussians. In general, the precision level of analytic simulation should be around 10^{-6}.

File (Matlab script): Convolution2DGaussians.m

Matlab script description

Appendix E (Freestone et al., 2011, NeuroImage), Equation (4) $(\phi_i \otimes \phi_j)(r) = (\frac{\pi\sigma_i^2\sigma_j^2}{\sigma_i^2+\sigma_i^2})^{\frac{n}{2}} \exp(-\frac{1}{\sigma_i^2+\sigma_i^2} r^T r)$**.**

Section: Generate spatial data, create a $NPoints \times NPoints$ cortical surface and phi and psi Gaussian basis functions.

Variable name	Explanation
X	Coordinates of x-axis
Y	Coordinates of y-axis
mu_phi	Centre of gaussian
sigma_phi	covariance matrix of phi
phi	Gaussian basis function
mu_psi	Centre of gaussian
sigma_psi	covariance matrix of psi
psi	Gaussian basis function

Analytic check of convolution of two Gaussians.

Variable name	Explanation
mu	Centre of a gaussian resulted from convolution of two gaussians, phi and psi
var_phi	variance of gaussian phi
var_psi	variance of gaussian psi
exponential	exponential part of Equation Appendix E.4 (Freestone et al. 2011)
CovMat	covariance matrix of a resultant gaussian convolved by two other gaussians
coefficient	coefficient part of Equation Appendix E.4 (Freestone et al. 2011)
convE2_equivalent	analytic result of convolution of two gaussians, phi and psi

2 Compute Gamma

File (Matlab script): ComputeGamma.m

Matlab script description

This matlab script mainly implement and estimate the following two equations, (21) and Appendix (D.7) (Freestone et al. 2011 NeuroImage).

Field, v(r), is decomposed of a finite-dimensional state vector and a vector of Gaussian basis functions.

Define $\Gamma = \int_\Omega \phi(r)\phi^T(r)dr$. Firstly, programmatically define $\phi(r)$, as a vector of Gaussian basis functions. Each Gaussian function is defined as $\phi(r - r') = \exp\left(-\frac{(r-r')^T(r-r')}{\sigma_\phi^2}\right)$.

3 Compute Psi

Compute